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A Preliminary Examination of the Parasite Fauna of Yellowtail Rockfish, *Sebastes Flavidus*

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ABSTRACT

Lee, D. L., D. J. Whitaker, and R. D. Stanley. 1990. A preliminary examination of the parasite fauna of yellowtail rockfish, Sebastes flavidus. Can. Tech. Rep. Fish. Aquat. Sci. 1777: 21 p.

Complete necropsies were performed on 40 yellowtail rockfish, Sebastes flavidus. Twenty specimens were taken from a sample captured off Cape Scott, British Columbia and 20 were from a sample collected near Destruction Island, Washington State. The principal objective of the study was to identify which parasites show potential as biological tags for the purpose of stock identification. Secondary objectives included outlining a general necropsy procedure and creation of a reference collection of identified parasites for future studies of this fish species. Prevalence and intensity rates are summarized. Twenty different parasites were recorded in this survey, several of which appear to show promise as biological tags. These include the monogenean, Microcotyle sebastis and a species of Copepoda, Neobrachiella robusta, both of which occupy the opercular cavity; Chondracanthus triventricosus, a species of copepoda which is found in the nasal cavity; and four species of Digenea from the digestive tract; Derogenes varicus, Plagioporus sp., Lecithochirium exodicum and Podocotyle sp. In addition, M. sebastis, Myxidium japonicum, Myxidium sp., Leptotheca sp. and Pleistophora sp. are recorded from S. flavidus for the first time.

RÉSUMÉ

Lee, D. L., D. J. Whitaker, and R. D. Stanley. 1990. A preliminary examination of the parasite fauna of yellowtail rockfish, Sebastes flavidus. Can. Tech. Rep. Fish. Aquat. Sci. 1777: 21 p.

Des nécropsies complètes ont été effectuées sur 40 sébastes à queue jaune, Sebastes flavidus, provenant, à parts égales, de deux échantillons différents: l'un recueilli au large du cap Scott, en Colombie-Britannique, et l'autre, à Destruction Island, dans l'État de Washington. Le principal objectif de cette étude consistait à repérer certains parasites susceptibles de s'avérer de bons indicateurs biologiques pour l'identification des stocks. L'établissement d'une procédure générale de nécroscopie et la création d'une collection de parasites identifiés utiles à titre de référence pour de futures études sur ce sébaste étaient au nombre des objectifs secondaires. La prévalence et l'intensité du parasitisme sont présentées. Vingt parasites différents ont été observés, dont plusieurs pourraient s'avérer de bons indicateurs. C'est le cas du Monogène Microcotyle sebastis et d'une espèce de copépode, Neobrachiella robusta, tous deux occupant la cavité operculaire; de Chondracanthus triventricosus, un copépode présent dans la cavité nasale; et de Derogenes varicus, Plagioporus sp., Lecithochirium exodicum et Podocotyla sp., quatres espèces de Digènes présents dans le tube digestif. Par ailleurs, la présence de M. sebastis, Myxidium japonicum, Myxidium sp., Leptotheca sp. et Pleistophora sp. est signalée ici pour la première fois chez S. flavidus.

INTRODUCTION

The Canadian and U.S. trawl fisheries for yellowtail rockfish (Sebastes flavidus) off the coasts of British Columbia, Washington, and Oregon produce over 11,000 tonnes annually (Rutherford 1988). These fisheries are regulated through a combination of area-specific closures, trip limits, and annual quotas. Area-specific management is based on the premise that there is more than one stock although supporting information on stock identification is limited (Tagart 1988; Stanley 1989).

In hopes of providing a sounder biological basis for stock boundaries, staff from the Department of Fisheries and Oceans, Canada (DFO) and the Washington Department of Fisheries (WDF) initiated a study of the parasites of this species in 1988. The purpose was to explore the possibility of using parasites as biological tags to identify stock boundaries. To that aim, samples of adult S. flavidus were collected from the commercial trawl grounds in the fall of 1988 and again in the summer of 1989.

Because comprehensive necropsies are time consuming and often impractical for large collections, we conducted a detailed examination of a sub-sample of the fish collected, with the intent of using the results to identify parasites which showed the most promise for stock identification. The present report documents the methods, results, and recommendations from this preliminary survey of the parasite fauna of yellowtail rockfish.

MATERIALS AND METHODS

We examined 40 yellowtail rockfish from 2 locations. Twenty were collected near Cape Scott, at the northern tip of Vancouver Island (51°14'N x128°58'W) (Fig.1). They were captured on November 8, 1988, by bottom trawl at a depth of 188-196 m (Tow #8, Gillespie and Stanley 1989) and frozen within 2 hours of capture. A second sample of 20 fish was taken from a commercial landing caught off Destruction Island (47°81'N x 124°53'W) in Washington State. They were captured by mid-water trawl at a depth of 150 m on November 13, 1988, and frozen within 24 hours of capture. Ten were examined at the same time as the Cape Scott sample when we were using the complete necropsy protocol. The remaining 10 fish were examined at a later date, when we were examining selected organs and tissues (Table 2).

Necropsy Procedure

After thawing, the length, weight, and sex of the fish were recorded. The external surface, including the fins, nasal and branchial cavities, were examined by eye for ectoparasites.

The fins, gills, eyes, and internal organs, including the brain, were removed and placed in separate dishes. All external surfaces were examined under a dissecting microscope at 6-75X. Any cysts or lumps were removed for closer inspection. The stomach, caeca and intestine were opened, and the contents collected separately and suspended in tap water. After allowing the mixture to settle, the solution was decanted and the remaining material was examined for parasites. The internal surfaces of the stomach, heart and swim bladder were examined under the dissecting microscope. The external and internal surfaces of the eyeball and the vitreous humour were also inspected.

The skin of the fins and body was removed and the inner surface was checked for cysts. The fin musculature was also examined. The body was filleted and the musculature thinly sliced and pressed between glass plates to be examined under the dissecting microscope for encysted or encapsulated parasites. Wet mounts were made from fluid collected from the musculature and examined for Myxozoa under a compound microscope with phase contrast illumination at 160-1000X.

After an initial inspection of the gills, the mucous was collected, mixed, and suspended in water. After decanting, the remaining material was examined for parasites with a dissecting microscope. Infected gill filaments were removed with the parasites still attached since the attachment organ can be important for species diagnosis. The blood vessels of the gill arches were also opened and examined.

The urinary and gall bladders were opened and the contents and scrapings of the inner surfaces prepared as wet mounts and also examined for Myxozoa.

Preservation and Staining Procedures:

Parasites were fixed in 10% formalin or aceto-formol-alcohol (AFA). The formalin was replaced after a few days with 70% ethanol.

Juvenile Acanthocephala were removed from their capsules prior to fixation. If the proboscis was inverted, the

acanthocephalan was placed in a dish of distilled water to evert the proboscis. If the proboscis still did not evert, the acanthocephalan was stroked gently with a probe to induce eversion.

Staining Procedures:

For Digenea, Monogenea, Cestoda, and Acanthocephala, the parasites were removed from the vials and placed in small, fine mesh baskets for ease of handling. Parasites that were still in formalin were rinsed in water, and then dehydrated, first in 30% and then 70% ethanol. If the parasites were in AFA or alcohol, they were put directly into fresh 70% ethanol. The specimens were left in each solution for 5 minutes or longer, depending on the size of the organism. They were then placed in alcoholic Semichon's acetic carmine for staining. The time required in the stain was dependent on the size of the parasite and varied from a few minutes to several hours. Once stained, the specimens were rinsed in 70% ethanol followed by acid alcohol and basic alcohol. Placing the stained specimen in ethanol or acid alcohol causes destaining. After the required differentiation had been achieved, further destaining during the dehydration sequence was prevented by placing the parasites in basic alcohol for a few minutes to set the stain.

After differentiation, the specimens were dehydrated by passing them through a series of 70%, 90%, and 95% ethanol followed by two changes of 100% ethanol. The parasites were left in each change for approximately 5 minutes and slightly longer in the 100% ethanol to ensure complete dehydration. The baskets used to carry the specimens from one solution to the next were blotted between transfers. After several runs, all solutions were replaced.

Once the dehydration sequence was completed, the specimens were cleared in xylene. Xylene eliminates the alcohol and increases the refractive index of tissues, making the specimen relatively transparent. Specimens were taken from the xylene and mounted immediately in permount.

When permanent slides of Myxosporea or Microsporea were required, the fluid or cyst containing these parasites was spread onto a clean microscope slide. For Myxosporea, the resulting smear was left to air dry, fixed in 70% ethanol, and stained with methylene blue. Methylene blue was used to stain the polar capsules, one of the distinguishing structures of Myxosporea. Tissue gram stain was used for Microsporea,

RESULTS

The Cape Scott sample consisted of 6 females and 14 males (Table 1). The mean weight was 1425 grams and mean fork length was 45 cm. The Destruction Island sample consisted of 11 females and 9 males. Mean weight and fork length of the Destruction Island fish were 1692 grams and 46 cm, respectively.

Twenty different parasites were recovered. Data are summarized in terms of prevalence, mean intensity, intensity range, and site of recovery (Table 2). In cases where fish were infected with Myxosporea or Microsporea, only the prevalence and site of infection were given. The data from this study are compared with those of Sekerak (1975) in Table 3.

Microsporea

All Microsporea are characterized by a single polar capsule contained within their very small spores. Brown cysts in the musculature of S. flavidus were found to contain spores of a species of the microsporean Pleistophora. Prevalence was similar in both samples. This is the first record of Pleistophora in S. flavidus.

Myxosporea

Species of Myxosporea are identified by the number and shape of the valves of the spore, the number and position of the polar capsules in the spores, and spore size. Three species from two genera of Myxosporea were found in this survey. Two species of Myxidium; M. japonicum and an unidentified species, were found in the gall bladders. Myxidium japonicum which was found at a slightly higher prevalence at Cape Scott, has not been recorded from S. flavidus previously. The unidentified species of Myxidium was also found at a slightly higher prevalence at Cape Scott. Another myxosporean, also from the gall bladder and tentatively identified as a species of Leptotheca, was found to have the same prevalence level in both samples (Table 2). The unidentified species do not correspond with the descriptions of any of the known species of Myxidium and Leptotheca and have not been previously recorded for S. flavidus.

Monogenea

Microcotyle sebastis is an ectoparasite which anchors itself to the gill filaments of its host by the use of haptoral clamps. The prevalence of M. sebastis at Cape Scott was much lower than at Destruction Island (Table 2). This is the first record of M. sebastis to be found on S. flavidus although it has been recorded for other species of Sebastes (Beverley-Burton 1984).

Digenea

Eight species of Digenea, comprising two life stages, were recorded (Table 2). Juvenile forms (metacercariae) were found encysted in the orbits of the eyes, fins, and musculature. Adult Digenea were found in the digestive system. Metacercariae of Prosorhynchus crucibulum and Stephanostomum sp. A were found with similar prevalence levels in both samples while those of Stephanostomum sp. B were found at very low levels only at Destruction Island.

Adult specimens of Derogenes varicus were more prevalent in the Destruction Island sample, while Plagioporus sp. and Opechona occidentalis were more prevalent at Cape Scott. Although seen at low levels, both Lecithochirium exodicum and Podocotyle sp. were present only in the Cape Scott sample.

Being internal parasites, adult Digenea are not usually found on the external surfaces of their hosts, but specimens of Derogenes varicus were found on the gills of all Destruction Island fish. They may have been regurgitated with the stomach contents during capture or they may have migrated out of the digestive tract following post mortem changes in the fish.

Cestoda

Pleurocercoids (Nybelinia surmenicola) were found encapsulated in the mesenteries and the stomach walls of their hosts. Although the prevalence was greater in the Cape Scott sample (Table 2), this parasite is accumulated with the age of the fish. Before N. surmenicola can be used as a tag this factor would have to be accommodated by comparing the ages of the fish in the samples.

Nematoda

Larval forms of the Anisakidae are widespread in marine fishes, which are intermediate hosts for these nematodes. The definitive hosts are usually marine mammals. Two different nematodes of the family Anisakidae were recorded in this study. The most common were Anisakis sp. Fourteen Cape Scott fish and all Destruction Island fish carried Anisakis sp.

A single specimen of the nematode Pseudoterranova sp. was found encapsulated in the musculature of a Cape Scott fish.

Acanthocephala

All Acanthocephala found in the present study belong to the genus Corynosoma. Fish are the second intermediate hosts for Corynosoma species and marine mammals are the definitive hosts. Although Corynosoma spp. are normally found encapsulated on the fish's mesenteries and viscera, the single Corynosoma found in the Cape Scott sample was found encapsulated in the pericardial sac. The two specimens found in the Destruction Island sample were from the stomach and may have originated from ingested prey.

Copepoda

Three species of Copepoda (Chondracanthus pinguis, C. triventricosus and Neobrachiella robusta) were found in the current study. All were either ovigerous or nonovigerous females. No juvenile stages or males of any species were found. Chondracanthus pinguis was found at the same prevalence (60%) in both samples but with a greater intensity of infection in the Destruction Island sample.

The prevalence of C. triventricosus was much greater at Destruction Island when compared to the Cape Scott sample (Table 2). Sekerak (1975) also recorded this parasite as common in his fish from Queen Charlotte Sound (Table 3).

Neobrachiella robusta was also found more frequently at Destruction Island (Table 2).

DISCUSSION

The potential of any parasite as a biological tag depends on a number of factors. A primary factor is the variation in abundance of the parasite among sample locations with respect to its presence or absence, prevalence, and intensity of infection. Also important is the site of infection and the possibility of the parasite being lost during capture and handling. It is also necessary to consider the biology of the parasite. The abundance of some parasites is correlated with the age of the host fish and other parasites can affect the fish's health and its susceptibility to predation. Seasonal variation is another factor which must be considered, especially when samples have been taken at different times of the year. A non-biological factor which should be considered, particularly when large numbers of fish are being sampled, is the time required to find and identify those parasites selected as biological tags.

All of these are important factors but, for the purposes of this survey, it was decided that the differences in parasite prevalence and intensity and the time required to find and identify the parasites were of greatest importance. Seasonal variation was not a consideration in this study because both samples were taken at the same time of year.

The following is an evaluation of the potential of the different parasites found in this survey as biological tags in light of the above factors.

Microsporea and Myxosporea

Although Microsporea and Myxosporea have not been used previously as tags for rockfish, they have been used for other species (Sindermann 1957; Putz 1970; Olson and Pratt 1971). The microsporean, Pleistophora, was observed in the current study, however, the prevalence in the musculature was too low in both samples to make it useful as a tag. Furthermore, the examination of the musculature is time consuming and light intensities can easily be missed which further limits the utility of this parasite as a tag.

The two species of Myxidium and one species of Leptotheca found in this survey show some potential as tags. These myxosporean parasites which reside in the gall bladders of their hosts are easily detected. Also large numbers of gall bladders can be excised quickly and preserved for later examination. Unfortunately, the prevalence levels of these

parasites in this survey were similar in both samples. Further sampling of different stocks will be required to determine if they will make viable tags.

Monogenea

One of the parasites that showed the most promise for stock identification is the monogenean, M. sebastis. M. sebastis has been used previously to separate stocks of Sebastes serranoides off the coast of southern California (Love 1980). This parasite is found attached to the gill filaments of the host. Since the gills are protected by the operculum and M. sebastis has a strong attachment organ, the parasite is not readily lost during capture and handling. Differences in prevalence between the two samples were seen in this study.

Digenea

Juvenile stages of Digenea show some promise as tags since metacercariae are capable of surviving in their hosts for long periods. However, metacercariae of both P. crucibulum and Stephanostomum sp. were found encysted in the skin and musculature of their host and require considerable time to identify. Similar infection levels at both locations also make these parasites unlikely candidates for biological tags.

The observations of adult Digenea found in the intestines, stomach, and caeca in this study must be viewed with caution. Because of the delay in freezing of the Destruction Island specimens, the intestinal walls of these specimens had ruptured causing the contents to be released into the body cavity. However, a number of species of trematodes were successfully recovered from the digestive tract of these fish and several of these could be considered for future studies. Lecithochirium exodicum, for example, was present in the Cape Scott sample but was not found in the Destruction Island fish. Another trematode, Podocotyle sp. was also found in the Cape Scott sample but was not found in the Destruction Island sample. Although both these species were found at prevalence levels generally considered to be too low for use as tags, additional sampling may indicate higher levels. Future samples should be frozen more promptly if Digenea are being considered as possible tags.

Sekerak (1975) observed the sanguinicolid blood fluke Psettarium sebastodorum in a Strait of Georgia sample. However,

because it was not observed in any of our offshore samples it would have little value in our attempts to distinguish among offshore stocks.

Cestoda

Although N. surmenicola was recorded with a higher prevalence in the Cape Scott sample, the age accumulation factor and the time required to dissect out and identify the parasite limits its use as a tag.

Nematoda

Sekerak (1975) found that among the Metazoa, nematodes were the most prevalent, followed by cestodes and digeneans. All the nematodes found in the fish examined in this study were anisakids. They were found throughout the host tissue and were difficult to distinguish one from another thus making an examination of each fish very time consuming. Another disadvantage of anisakid infections is that they can be age dependent (Margolis 1982). Finally, researchers who have used Anisakis species as biological tags have often not attempted specific identification of the larvae, making the use of these parasites very complicated (MacKenzie 1983). Nevertheless, larval nematodes have been used successfully as biological tags to differentiate stocks of S. marinus (Sindermann 1961) and herring (Beverley-Burton and Pippy 1977). One advantage of using larval nematodes as tags is that they are found encapsulated in the flesh and body cavity of their hosts where they cannot be lost at capture or by subsequent handling.

Sekerak (1975) observed the nematode Ascarophis sebastodis in his Strait of Georgia sample, but this parasite was not found in the current survey.

Acanthocephala

Although Corynosoma sp. meets most of the requirements of a good biological tag, only three specimens were found and two of these were found in the stomach and may have been infecting a fish ingested as a food item. It would probably therefore, have little use as a tag for S. flavidus.

Echinorhynchus gadi, recorded by Sekerak (1975), was not observed in the present study.

Copepoda

The copepods N. robusta, found in the opercular cavity, and C. triventricosus, found in the nasal cavities, show promise for stock identification. These parasites like the monogeneans, are generally considered to be ectoparasites, are easily recognized and are site specific. Because the gills are protected by the operculum, N. robusta is not easily lost due to handling during capture. Although N. robusta was found to have a low prevalence in both samples, it has been used successfully as a tag by Leaman and Kabata (1987) for Pacific Ocean Perch (Sebastes alutus) . However, they reported a much higher prevalence of immature and male stages than were seen in this study.

Chondracanthus triventricosus is also protected from loss during capture and handling by its location in the nasal cavities. It is readily identified and in this study exhibited differences in prevalence between the two samples.

The absence of adult male and juvenile stages of parasitic Copepoda in this survey may be the result of seasonal fluctuations in the composition of the copepod populations or to the small number of fish examined. In many parasitic copepod species, however, the males are characterized by extremely short life spans and in several species, the males have yet to be discovered (Kabata 1970). It is interesting to note the general reduction in prevalence and intensity of infection of these three species between the sample from Cape Scott in the north compared to the Destruction Island sample in the south. Leaman and Kabata (1987) reported a similar response in the populations of N. robusta.

Other copepod species not seen in this survey but found in an earlier study of S. flavidus (Sekerak 1975), include Colobomatus kyphosus and Clavella parva. Colobomatus kyphosus is found in the cephalic canals and would be time consuming to locate. Clavella parva was restricted to the Strait of Georgia in Sekerak's study.

SUMMARY

Twenty different parasites were found associated with S. flavidus (Table 4). Of these; M. sebastis, M. japonicum, Myxidium sp., Leptotheca sp., and Pleistophora sp. have not been previously reported from S. flavidus.

The most promising parasites for use as biological tags for S. flavidus appear to be: the monogenean M. sebastis, the copepod N. robusta found on the gill filaments and operculum; the copepod C. triventricosus found in the nasal cavity; and perhaps the Myxosporea of the gall bladder. If additional dissection time is available, the necropsy procedure could include the digeneans of the digestive tract which showed differences in distribution between the two samples. This, however, will depend on the condition of the digestive tract of the remaining fish in the collections.

Anisakidae represent some potential as biological tags, but only if dissection time is not limited.

No parasites were found in the spleen, heart, swim bladder, liver, and the inside of the eyes. These organs and tissues can be eliminated from the examination.

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Table 1. Fork length, weight, and sex of S. flavidus examined for parasites.

Fish #	Length (cm)	Weight (g)	Sex
CAPE SCOTT, B.C.			
BMLRF 46701	43	1008	M
02	44	1295	M
03	43	1395	F
04	48	1912	F
05	44	1225	M
06	45	1357	M
07	48	1751	M
08	49	1711	M
09	47	1675	M
10	43	1369	M
11	37	1121	F
12	46	1385	F
13	48	2020	F
14	43	1245	F
15	42	1045	M
16	47	1663	M
17	44	1248	M
18	44	1212	M
19	48	1505	M
20	44	1350	M
DESTRUCTION ISLAND, WASHINGTON			
BMLRF 46721	47	1495	M
22	46	1368	M
23	42	1233	M
24	43	1262	M
25	42	1018	M
26	49	2179	F
27	46	1993	F
28	50	2243	F
29	50	1933	F
30	52	2561	F
45101	43	1242	M
02	44	1510	F
03	49	2051	F
04	43	1218	M
05	46	1752	F
06	49	1902	F
07	37	829	M
08	44	1250	M
09	53	2860	F
10	47	1942	F

Table 1 (cont'd)

Sampling location	Length (range)	Mean length	Weight (range)	Mean weight	M	F
Cape Scott	37-49 cm	45 cm	1008-2020 g	1425 g	14	6
Destruction I.	37-53 cm	46 cm	829-2860 g	1692 g	9	11

Table 2. Parasites recovered from *Sebastes flavidus* collected at Cape Scott and Destruction Island.

Parasite	Samples: Cape Scott (B.C.) (n=20) Prevalence (%)	Mean intensity	Intensity range	Site	Destruction Is. (Wash.) (n=20) Prevalence (%)	Mean intensity	Intensity range	Site
MICROSPOREA*								
Pleistophora sp.	10.0	-	-	Musculature	10.0	-	-	Musculature
MYXOSPOREA+								
Leptotheca sp.	15.0	-	-	Gall bladder	16.7	-	-	Gall bladder
Myxidium sp.	20.0	-	-	Gall bladder	16.7	-	-	Gall bladder
Myxidium japonicum	20.0	-	-	Gall bladder	16.7	-	-	Gall bladder
MONOGENEA								
Microcotyle sebastis	10.0	1.0	1	Gill filaments	50.0	2.2	1-3	Gills
DIGENEA								
Derogenes varicus	5.0	1.0	1	Stomach	40.0	1.0	1	Gills
Lecithochirium exodicum	5.0	2.0	2	Intestines	0.0	-	-	-
Opechona occidentalis	50.0	3.6	1-12	Intestines, pyloric caeca	30.0	1.8	1-5	Intestines, pyloric caeca
Plagioporus sp.	50.0	6.5	1-24	Intestines, pyloric caeca	10.0	2.0	1-3	Intestines
Podocotyle sp.	10.0	1.5	1-2	Intestines pyloric caeca	0.0	-	-	-
*Prosorhynchus crucibulum** (metacercaria)	20.0	3.0	1-6	Fins, skin, musculature	30.0	1.0	1	Skin
Stephanostomum sp.A* (metacercaria)	25.0	1.8	1-4	Skin musculature	30.0	3.0	1-4	Skin, fins
Stephanostomum sp.B* (metacercaria)	0.0	-	-	-	10.0	4.0	4	Brain surface
CESTODA								
Nybelina surmenicola (pleuroceroid)	45.0	4.3	1-13	Mesenteries, stomach wall	10.0	4.8	1-8	Mesenteries, stomach wall
NEMATODA*								
Anisakis sp. (larva)	70.0	8.7	1-43	Mesenteries, viscera, musculature	100.0	3.7	1-8	Mesenteries, viscera, musculature, body cavity
Pseudoterranova sp. (larva)	5.0	1.0	1	Musculature	0.0	-	-	-
ACANTHOCEPHALA								
Corynosoma sp. (juvenile)	10.0	1.0	1	Pericardial sac	10.0	1.0	1	Stomach

Table 2 (cont'd)

Parasite	Samples							
	Cape Scott (B.C.) (n=20)				Destruction Is. (Wash.) (n=20)			
	Prevalence (%)	Mean intensity	Intensity range	Site	Prevalence (%)	Mean intensity	Intensity range	Site
COPEPODA								
Chondracanthus pinguis	60.0	1.3	1-2	Gill filaments, operculum	65.0	2.5	1-8	Gills, operculum
Chondracanthus triventricosus	5.0	1.0	1	Nasal cavities	30.0	3.2	1-4	Nasal cavities
Neobrachiella robusta	5.0	1.0	1	Operculum	20.0	3.3	1-6	Operculum

*The last 10 fish from Destruction Island were not examined for these parasites.
+Only 18 fish from Destruction Island were examined for Myxospores.

Table 3. Comparison of number of infected S. flavidus specimens between the present study and Sekerak (1975).

	Sekerak (1975)		Present study	
	Strait of Georgia	Qu. Char. Sd.*	Cape Scott	Destruction Island
No. examined	(6)	(10)	(20)	(20)
MICROSPOREA				
Pleistophora sp.	0	0	2	1
MYXOSPOREA				
Leptotheca sp.	0	0	3	3
Myxidium sp.	0	0	4	3
Myxidium japonicum	0	0	4	3
MONOGENEA				
Microcotyle sebastis	0	c	2	10
Trochopus sp.	0	2	0	0
DIGENEA				
Digenea sp.	1	0	0	0
Derogenes varicus	5	9	1	8
Hemiuridae	1	2	0	0
Lecithochirium exodicum*	0	1	1	0
Lecithophyllum botryophorum	0	1	0	0
Neohelicometra sebastis	0	3	0	0
Opechona alaskensis	0	1	0	0
Opechona occidentalis	3	1	10	6
Plagioporus sp.	0	0	10	2
Podocotyle sp.	2	8	2	0
Prosorhynchus crucibulum (metacercaria)	0	4	4	3
Psettarium sebastodorum	2	0	0	0
Stephanostomum sp. A (metacercaria)	0	0	5	2
Stephanostomum sp. B (metacercaria)	0	0	0	1
Syncoelium filiferum	0	2	0	0
CESTODA				
Nybelina surmenicola (pleurocercoid)	6	10	9	4
NEMATODA				
Ascarophis sebastodis	1	0	0	0
Anisakis sp. (larva)	0	0	14	10
Capillaria sp. (larva)	1	1	0	0
Contracecum sp. (larva)	6	10	0	2
Culcullanus sp. (larva)	0	1	0	0
Pseudoterranova sp. (larva)	0	0	1	1
Hystrothylacium aduncum*	5	4	0	0

Table 3 (continued)

	Sekerak (1975)		Present study	
No. examined	Strait of Georgia (6)	Qu. Char. Sd.[a] (10)	Cape Scott (20)	Destruction Island (20)
ACANTHOCEPHALA				
Corynosoma sp. (juvenile)	0	0	2	2
Echinorhynchus gadi	2	0	0	0
COPEPODA				
Chondracanthus pinguis	3	2	12	6
Chondracanthus triventricosus	1	8	1	4
Clavella parva	3	0	0	0
Columbatus kyphosus	1	5	0	0
Neobrachiella robusta	0	1	1	1

[a]Queen Charlotte Sound.
[b]Recorded as Sterrhus exodicus by Sekerak (1975).
[c]Recorded as Thynnascaris aduncum by Sekerak (1975).

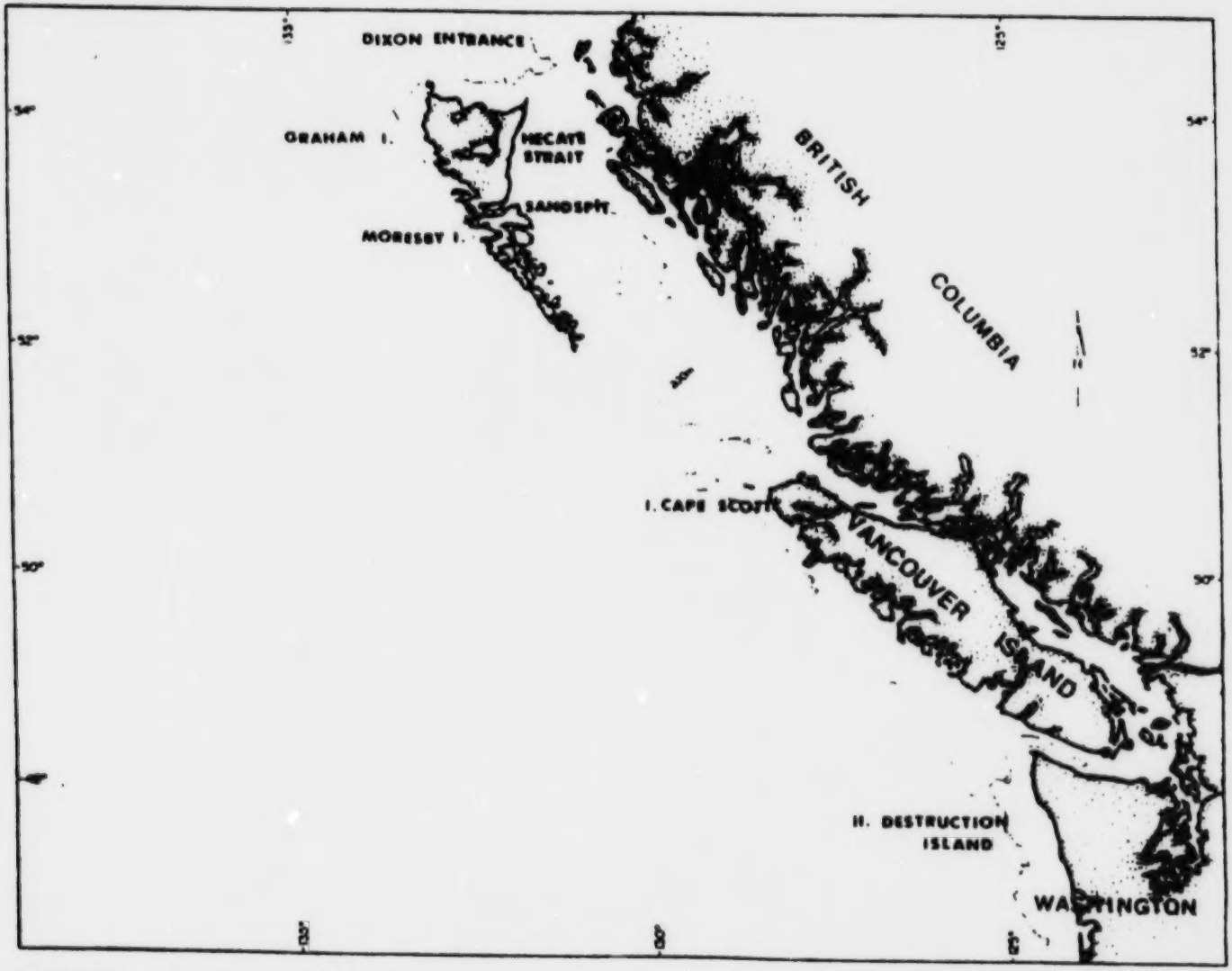

FIGURE 1. SAMPLING LOCATIONS

I. CAPE SCOTT

II. DESTRUCTION ISLAND